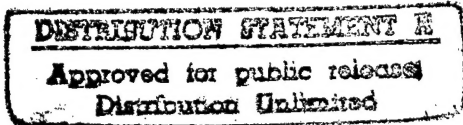


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25 May 1995

Dr. Steven Ramberg  
ONR Code 321  
Ballston Towers One  
800 N. Quincy St.  
Arlington, VA 22217-5660

19960610 167

Subject: Final Report for ONR Grant, N00014-92-J-1273, Harry L. Bryden, Principal Investigator

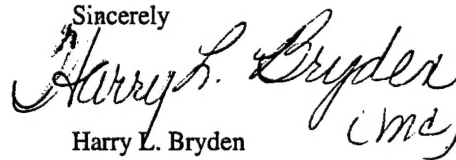
Dear Dr. Ramberg:

I am writing to provide a final technical report on ONR Grant N00014-92-J-1273 entitled *Gibraltar Exchange Measurements*. The central purpose of this grant was to allow completion of the analysis of the Gibraltar Experiment current meter measurements made during 1985-86 and final publication of the results. During the last five years of this project, we have published a total of 10 papers on these Gibraltar measurements (as detailed on the attached list of publications) including a major review paper on the progress made in understanding strait dynamics as a result of the Gibraltar Experiment; two theoretical studies of two-layer exchange; two examples of the control exerted by the Strait of Gibraltar on long-term changes in Mediterranean circulation; as well as five papers describing the exchange processes and quantifying the mass, heat and freshwater fluxes through the Strait. With the publication in Progress In Oceanography of our summary paper on the nature of the exchange through the Strait of Gibraltar, I feel that all primary analyses and publications resulting from my Gibraltar work over the past decade are now complete.

I would like to thank the Office of Naval Research for their long-term support of the Gibraltar work. It was a bit more than 10 years ago when a group of scientists indicated our interests in developing an observational and theoretical study of the Gibraltar exchange to ONR. Encouraged by Dr. Dennis Conlon then an ONR Program Manager, we developed a major field program in the Strait during 1985-86. Analysis of the resulting measurements combined with development of theoretical models for two-layer exchange have led to marked improvements in our understanding of strait dynamics and exchange. Most notably, we have found the exchange to be only about half as large as had been previously thought; and the theoretically predicted exchange is remarkably within 15% of the observed exchange. Moreover, we have developed a parameterisation for the exchange that can be used in large-scale ocean circulation models which cannot properly resolve the Strait and we have developed a strategy for continuously monitoring the exchange. Throughout the field program and the analysis and publication phase of the Gibraltar Experiment, we have had stimulating scientific discussions with our colleagues on strait dynamics and the nature of the exchange. This interaction has been possible due to the farsighted policy at ONR to allow suitable time for analysis, discussion and publication of the results for a major field program. On behalf of

the Gibraltar Experiment scientists, I would like to thank you and earlier program managers Drs. Dennis Conlon, Alan Brandt and Thomas Kinder for the opportunity to contribute to such an exciting and productive research program.

If you require any additional information, I would be happy to provide it.

Sincerely  
  
Harry L. Bryden

cc: Robert Tanner  
Director, NRL  
Defense Technical Information Center

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**Publications on Gibraltar Exchange by Harry L. Bryden during 1990-1994**

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- Bryden, H. L., 1993. Sill exchange to and from enclosed seas. *In: Symposium, Mediterranean Sea 2000*, September 1991, N. F. R. Della Croce, Editor, Istituto Scienze Ambientali Marine, Santa Margherita Ligure, 17-36.
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